

WHAT IS CLAIMED IS:

1. Method of attaching a relatively soft structural member to an underlying relatively hard structural member made of metal, said method comprising the steps of:

(a) providing fasteners comprising a shank having a head at one end, a tapered point at the opposite end, a drill portion that extends away from said tapered point for a fixed distance, and a screw portion commencing from adjacent said drill portion and extending toward said head; and

(b) driving said fasteners through said relatively soft structural member into said relatively hard structural member by first rotating them to cause said drill portion to penetrate said relatively soft structural member in a drilling action and then, when said fasteners have engaged said relatively hard structural member, repetitively impacting said fasteners while simultaneously subjecting them to rotational torque, whereby to cause said fasteners to penetrate said relatively hard structural member and lock said relatively soft structural member to said relatively hard structural member.

2. Method according to claim 1 wherein (1) said drill portion drills aligned holes in said relatively soft structural member and said relatively hard structural member, and (2) said screw portion cuts a helical screw thread in and makes a screw connection with said relatively hard structural member.

3. Method according to claim 2 wherein the diameter of said screw portion exceeds the diameter of said drill portion.

4. Method according to claim 3 wherein said drill portion comprises cutting flutes and said screw portion comprises a helical screw thread.
5. Method according to claim 1 wherein said first structural member is made of a hard wood material and said second structural member is made of a metal.
6. Method according to claim 5 wherein said second structural member is made of steel.
7. Method according to claim 5 wherein said second structural member comprises a structural portion of a shipping container, truck body or truck trailer body.
8. Method according to claim 1 wherein said fasteners are mounted in a plastic strip that comprises a plurality of hollow cylindrical carriers attached to one another in series, with each fastener mounted in its own carrier, and further wherein step (b) involves driving said fasteners out of said carriers without separating said carriers from one another.
9. Method according to claim 1 wherein said carriers have top and bottom end surfaces and said shanks of said fasteners are gripped by said carriers with said fastener heads extending above said top end surfaces of said carriers, and further wherein said fastener heads have a maximum diameter not exceeding the inner diameter of said hollow cylindrical carriers, whereby to facilitate expelling said fasteners lengthwise out of said bottom ends of said carriers responsive to rotational forces applied to said heads of said fasteners.

10. Method according to claim 9 wherein each of said cylindrical carriers has inwardly facing ribs that surround and grip the shank of one of said fasteners, and the heads of said fasteners are provided with cutting blades for cutting away said ribs as said fasteners are rotatively driven in a direction to expel them from said carriers.

11. Method according to claim 1 wherein said fasteners are driven according to step (b) by means of a rotary impact driver.

12. Apparatus for use in attaching structural members to one another using fasteners comprising:

a rotary impact driver having an output spindle, said driver being operable on command to rotate said spindle and to repetitively impact said spindle when said spindle encounters a predetermined level of resistance to rotation;

means connected to said spindle for supporting a tool bit in coaxial relation with said spindle so that rotational and rotary impact forces generated by said driver will be transmitted to said tool bit;

a positioning plate, said positioning plate having a top end surface and a bottom end surface, a fastener drive bore extending between and through said top and bottom surfaces, said fastener drive bore being coaxial with said spindle; and

telescoping means coupling said positioning plate to said driver so that said driver and said spindle can be moved toward and away from said top end surface of said positioning plate;

whereby when said bottom end surface of said positioning plate is positioned on a first structural member that is to be attached to an underlying second structural member, said telescoping means permits said driver and spindle to be moved toward said first structural member to bring

a tool bit attached to said spindle into engagement with the head of a fastener positioned in said fastener drive bore, so that operation of said driver will cause said fastener to be driven through said first structural member into said second structural member under the rotational and impact forces transmitted to said spindle by said driver.

13. Apparatus according to claim 12 further including biasing means urging said telescoping means in a direction to move said driver away from said top end surface of said positioning plate.

14. Apparatus according to claim 12 further including a tool bit attached to said spindle and extending into said fastener drive bore of said positioning plate.

15. Apparatus according to claim 14 wherein said tool bit is attached to said spindle by a quick-release connection means.

16. Apparatus according to claim 12 further including a magazine attached to said positioning plate having means for holding a clip of fasteners arranged in single file and means for pneumatic means for urging said telescoping means to move in a direction to move said barrel and said drive shaft away from said top end surface of said positioning plate when said driver is coupled to a source of pressurized fluid; and means for advancing the clip so that each fastener in turn is disposed in said fastener drive bore in position for driving engagement by a tool bit attached to said drive shaft.

17. Apparatus according to claim 16 further including travel limiting means for limiting the extent of movement of said driver relative to said fastener positioning plate.
18. Apparatus according to claim 17 wherein said travel limiting means includes a member movable with said driver and engageable with said positioning plate, said member being adjustable to vary the distance that said driver can move toward said positioning plate.
19. Apparatus according to claim 12 further including pneumatic means for applying a pneumatic force to said telescoping means so as to cause said telescoping means to move said driver and said spindle away from said top end surface of said positioning plate to a limit position.
20. Apparatus according to claim 19 further including valve means for controlling application of said pneumatic driving force to said telescoping means, and manually operated means for operating said valve means so as to terminate application of said pneumatic force to said telescoping means.
21. Apparatus according to claim 20 wherein said driver is a pneumatic driver, and further wherein control means also controls operation of said pneumatic driver.
22. Apparatus for use in connecting structural members together by means of fasteners, said apparatus comprising:
 - a pneumatically powered rotary impact driver having a housing and an output spindle extending from said housing, said driver being adapted for connection to a source of pressurized fluid for powering the driver and

being activatable, when connected to said source of pressurized fluid, to rotatively drive said spindle and also to repetitively impact said spindle when said spindle encounters a predetermined level of resistance to rotation;

a torque and impact transmitting unit comprising an elongate barrel having first and second ends and an axial bore, means at said first end of said barrel for securing said barrel to said driver, and a drive shaft attached to and coaxial with said spindle so as to form an extension of said spindle, said drive shaft being disposed within said axial bore and having an outer end remote from said spindle;

a positioning plate, said positioning plate having a top end surface and a bottom end surface, and a fastener drive bore extending between and through said top and bottom surfaces, said fastener drive bore being coaxial with said axial bore;

telescoping means coupling said positioning plate to said barrel so that said barrel and said drive shaft can be moved toward and away from said top end surface of said positioning plate;

pneumatic means for urging said telescoping means to move in a direction to move said barrel and said drive shaft away from said top end surface of said positioning plate when said driver is coupled to a source of pressurized fluid;

connection means for coaxially attaching to said outer end of said drive shaft a tool bit that is adapted to make a locking engagement with the head of a fastener positioned in said fastener drive bore; and

means for deactivating said pneumatic means whereby to allow said telescoping means to move in a direction to move said barrel and said drive shaft toward said positioning plate. whereby when said bottom end surface of said positioning plate is positioned on a first structural member that is to be attached to a second underlying structural member, said torque and

impact transmitting unit can be moved toward said member to bring a tool bit attached to said drive shaft into engagement with the head of a fastener positioned in said fastener drive bore, so that operation of said driver will cause said fastener to be driven through said first structural member into said second structural member under the rotational and impact forces transmitted by said drive shaft and said tool bit.

23. Apparatus according to claim 22 further including means for introducing fasteners into said fastener drive bore in position for driving engagement by a tool bit attached to said drive shaft.

24. Apparatus according to claim 22 wherein said barrel has a pair of longitudinally extending slide bores, and said telescoping means comprises a pair of slide rods slidably received in slide bores, with said slide rods having outer ends attached to said positioning plate.

25. Apparatus according to claim 24 wherein said slide rods have inner ends disposed in said slide bores, and said pneumatic means comprises means for injecting pressurized fluid into said slide bores so as to pneumatically force said slide rods to move in said slide bores toward said positioning plate.

26. Apparatus according to claim 22 further including adjustable stop means for limiting movement of said barrel and said drive shaft toward said positioning plate.

27. Apparatus according to claim 22 further including a tool bit attached to said outer end of said drive shaft by said connection means for engagement with a fastener positioned in said fastener drive bore.

28. Apparatus according to claim 22 wherein said driver has a handle, and further including an auxiliary handle attached to said torque and impact transmitting unit adjacent to said driver, whereby said apparatus may be held by an operator's two hands when used to drive fasteners.

29. Apparatus according to claim 22 further including a magazine attached to said positioning plate having means for holding a strip of fasteners arranged in single file and means for feeding those fasteners into said fastener drive bore in position for driving engagement by a tool bit attached to said drive shaft.

30. Apparatus according to claim 29 wherein said magazine is adapted to support a fastener clip comprising a plastic strip and a plurality of fasteners disposed within and supported by said strip.

31. Apparatus according to claim 22 further including a multi-port control valve means for controlling application of pressurized fluid to said pneumatic means and said driver, and further wherein said means for deactivating said pneumatic means comprises manually-operable means for controlling operation of said control valve means.

32. Apparatus for use in connecting structural members to one another by means of fasteners, said apparatus comprising:

- a rotary impact driver having a housing and an output spindle extending from said housing, said driver being operable on command to rotate said spindle and to repetitively impact said spindle when said spindle encounters a predetermined level of resistance to rotation;

- a torque and impact transmitting unit coupled to said driver, said unit comprising an elongate barrel having first and second ends and an axial

bore, an attachment means at said first end of said barrel for securing said barrel to said driver, and a drive shaft attached to and coaxial with said spindle so as to form an extension of said spindle, said drive shaft being disposed within said axial bore and having an outer end remote from said spindle;

a positioning plate, said positioning plate having a top end surface and a bottom end surface, a fastener drive bore extending between and through said top and bottom surfaces, said fastener drive bore being coaxial with said drive shaft;

telescoping means coupling said positioning plate to said barrel so that said barrel and said drive shaft can be moved toward and away from said top end surface of said positioning plate; and

means for coaxially attaching to said outer end of said drive shaft a tool bit that is adapted to make a locking engagement with the head of a fastener positioned in said fastener drive bore,

whereby when said bottom end surface of said positioning plate is positioned on a member that is to be attached to an underlying substrate, said torque and impact transmitting unit can be moved toward said member to bring a tool bit attached to said drive shaft into engagement with the head of a fastener positioned in said fastener drive bore, so that operation of said driver will cause said fastener to be driven through said member into said substrate under the rotational and impact forces transmitted by said drive shaft and said tool bit.

33. Apparatus according to claim 32 further including biasing means for urging said telescoping means in a direction to move said barrel and said drive shaft away from said top end surface of said positioning plate.

34. Apparatus according to claim 33 wherein said biasing means comprising mechanical spring means.
35. Apparatus according to claim 33 wherein said biasing means comprises pneumatic means.
36. Apparatus according to claim 32 further including a magazine attached to said positioning plate having means for holding a strip of fasteners arranged in single file and means for feeding those fasteners into said fastener drive bore in position for driving engagement by a tool bit attached to said drive shaft.
37. Apparatus according to claim 32 wherein said driver is a pneumatic rotary impact driver.
38. Apparatus according to claim 32 wherein said telescoping means comprises a pair of longitudinally extending slide bores in said barrel, and a pair of slide rods slidably received in slide bores.
39. Apparatus according to claim 38 wherein said slide rods have heads slidably disposed in said slide bores and said slide bores and said heads form cylinder/piston arrangements, and further wherein said biasing means comprises means for delivering a pressurized fluid to and removing pressurized fluid from said slide bores, whereby pneumatic forces may be applied to or removed from said heads to vary the position of said slide rods in said slide bores.
40. Apparatus according to claim 38 wherein said biasing means includes means for causing automatic delivery of pressurized fluid to said

slide bores when said barrel and said drive shaft have moved a predetermined distance toward said positioning plate.

41. Apparatus according to claim 38 further including manually operated means for terminating application of pressurized fluid to said slide bores.

42. Apparatus according to claim 38 wherein said biasing means comprises springs disposed in said slide bores and acting on said slide rods.

43 Apparatus according to claim 16 wherein each of said fasteners is pointed at one end and has a head at its opposite end, with said head having a conically shaped side surface and a plurality of mutually spaced cutting blades protruding from said side surface for cutting a countersink for said head in a structural member when said each fastener is rotatively driven through said structural member.

44. Apparatus according to claim 43 wherein said clip comprises a plastic strip having a top side and a bottom side and a series of holes extending between said top side and said bottom side, each hole having a plurality of internal ribs, and webs connecting said ribs at said top side of said strip, and further wherein each of said fasteners is disposed in one of said holes with its said head facing up and spaced from said top side of said strip and its said pointed end projecting below said bottom side of said strip, and said each fastener is gripped by the said ribs and webs of the hole in which it is disposed.

45. Apparatus according to claim 22 comprising additional pneumatic means for urging said telescoping means to move in a direction to move said barrel and said drive shaft toward said top end surface of said positioning plate when said driver is coupled to a source of pressurized fluid, and means for deactivating said additional pneumatic means when said first-mentioned pneumatic means is activated.

46. Apparatus according to claim 12 wherein said positioning plate is provided with foot rest means for permitting an operator of the apparatus to apply foot pressure to hold said positioning plate in engagement with a structural member that is to be attached to another structural member.